cultural resources was completed and included a review of literature and official documents, field inventories, and consultation with the California Native American Heritage Commission (Busby *et al*. 1990). The goal of the assessment was to identify any potentially important cultural resources located on SNL/CA, including prehistoric, historic, and Native American resources. The field inventories included all areas outside of the central building compound. Within the compound, the field inventories included all open or otherwise undeveloped areas. An assessment of the existing buildings was also conducted. Finally, the Native American Heritage Commission, and a person knowledgeable of resources important to the tribe that inhabited the area historically, was consulted to identify any religious resources and sacred sites important to Native Americans. The only resources identified on the site were the buildings and structures associated with SNL/CA—no prehistoric resources, Native American resources, or historic archaeological sites were identified. Busby *et al*. (1990) recommended that none of the buildings or structures identified were eligible or potentially eligible for the NRHP.

In October 2001, SNL/CA conducted an in-depth SNL/CA historic building survey (SNL 2001d). The survey provided an historic context within which the buildings would be evaluated for significance under the criteria listed above (SNL 2001f). At the time, there were 70 buildings on the site, of which 45 were included in the survey. These buildings included permanent and semipermanent facilities; temporary and mobile structures were not included. The survey found that none of the buildings were historically significant or eligible for the NRHP. The results of this historic building survey will be sent to the State Historic Preservation Officer (SHPO) for consultation.

#### 4.7.3.2 Unidentified Sites

Despite the apparent lack of important resources on SNL/CA, there remains the possibility for currently unidentified resources to be located there. These unidentified resources would most likely consist of buried archaeological sites. Soils underlying SNL/CA, which were deposited because of alluvial transport, are Holocene in age (deposited in the past 10,000 years) and thus there is the potential for buried sites. No buried archaeological sites have yet been discovered on SNL/CA. These types of resources would only be discovered during construction or other ground-disturbing activities.

### 4.7.4 Cultural Resource Protection at Sandia National Laboratories, California

Because activities at SNL/CA are conducted by a federal agency or by its contractors, there is a body of legislation applicable to all Federal agencies that protect cultural resources at SNL/CA (see Chapter 7). The DOE has implementing regulations and policies that follow this legislation. In addition, there are personnel assigned within DOE and SNL with responsibility for overseeing compliance with these regulations and policies. Proposed undertakings at the site undergo review by the DOE to determine if the proposed activity will affect important cultural resources. These determinations are then reviewed by the California SHPO. If there is a potential for impacts to occur, the DOE and the SHPO consult on measures to be implemented to avoid, reduce, or mitigate any potential adverse impacts.

## 4.8 AIR QUALITY

### 4.8.1 Definition of Resource

Measuring or modeling ambient pollutant concentrations and comparing the concentrations to the corresponding standards determine ambient air quality. The EPA has set the National Ambient Air Quality Standards (NAAQS) as directed by the *Clean Air Act* (CAA) of 1970 (42 U.S.C. §§7401-7671q) for several criteria pollutants to protect human health and welfare (40 CFR Part 50). The primary NAAQS are established at levels necessary to protect human health with an adequate margin of safety while the secondary NAAQS specify the levels of air pollution determined appropriate to protect the public welfare from any known or anticipated adverse effects associated with air contaminants. These pollutants include particulate matter less than 10 microns (µm) in diameter ($PM_{10}$), sulfur dioxide ($SO_2$), carbon monoxide (CO), nitrogen dioxide ($NO_2$), lead (Pb) and ozone ($O_3$).

In addition, two additional criteria pollutant standards promulgated by EPA, the 8-hour ozone standard and the standard for particulate matter up to 2.5 µm in diameter ($PM_{2.5}$), have recently been upheld by the courts with implementation of the standards expected around 2005. The EPA will then determine the attainment or nonattainment status of an area with respect to the new standards and require the states to submit an implementation plan to address any noncompliance.

Enforcement authority of the CAA regulations for nonradiological air emissions has been delegated to the local air quality management districts. SNL/CA is within the Bay Area Air Quality Management District (BAAQMD) that regulates emission sources under the CAA and State Ambient Air Quality Standards (SAAQS).

### 4.8.2 Region of Influence

Regional air quality is influenced by the quantity of air pollutants emitted to the atmosphere within the region, by the quantity of air pollutants transported into the region, and by local geography, meteorology, and climate. The ROI for SNL/CA air quality is the Livermore Valley basin. SNL/CA is located in the southeastern portion of

the Livermore Valley and is surrounded by hills ranging from 900 to 1800 ft above the valley floor. The topography surrounding SNL/CA helps to channel air pollutants through the valley. A predominant southwesterly wind enters the Dublin gap transporting air pollutants into the basin and then exits the Livermore Valley through the Altamont Pass transporting air pollutants from the valley. A northeast wind component recirculates a portion of air pollutants back into the valley.

## 4.8.3 Affected Environment

### 4.8.3.1 Regional Climatology

The climate in the San Francisco region is Mediterranean, characterized by cool, wet winters and hot, dry summers. The microclimates within the region are influenced by the Pacific Ocean. Generally, the coast often experiences fog and moderate temperatures, whereas the inland valleys experience more sunshine and extreme temperatures. In the summertime, it is not uncommon for the Livermore Valley to experience temperatures higher than coastal areas (such as San Francisco). In winter, temperatures in the valley are usually cooler than at the coast.

During the dry season (June through September), days are typically sunny and warm. The regional airflow is dominated by a sea breeze as cooler marine air from the coast passes through the valley to replace the rising warm air in the San Joaquin valley. The marine air enters the valley through the Dublin gap to the west and exits the valley to the east through the Altamont Pass, resulting in strong west-to-southwest winds. Summer thunderstorms are infrequent, and tornadoes and hail are rare. The high temperatures and clear skies are favorable to ozone formation, and the surrounding hills can trap pollutants, leading to high air pollution episodes.

During the wet season (October through May), the climate is dominated by the passage of winter storms. Most of the annual rainfall occurs during this period. The sea breeze is not as prevalent in winter because the differential heating between the coast and San Joaquin valley is minimal. Although the wind direction is predominately from the southwest, there is also a strong northeast wind. Winds are generally lighter during this period: however, very strong winds often occur during winter storm events. Although temperatures can drop below freezing, measurable snowfall is extremely rare. Winter weather conditions combined with the valley topography can create strong surface based inversions, which can trap pollutants at the surface, leading to high air pollution episodes.

The average daily maximum, minimum, and monthly temperatures for Livermore for the period of record 1930 through 2000 are as follows:

- The average daily maximum temperatures range from 56.3 degrees Fahrenheit (F) in January to 89.4 degrees F in July.
- The average daily minimum temperatures range from 36.1 degrees F in January to 54.0 degrees F in July.
- The average daily temperature is 59.2 degrees F.

The Livermore average monthly maximum and minimum rainfall for the period of record from 1930 through 2000 are as follows:

- January is the wettest month with 3.0 inches.
- July is the driest with 0.02 inches.
- The average annual rainfall is 14.5 inches.

### 4.8.3.2 Sandia National Laboratories, California Meteorology

The Livermore meteorology for 1996 to 2000 has been summarized using data obtained from a meteorological tower located in LLNL and is presented as follows:

- The highest daily maximum of 107.6 degrees F occurred in August 1998.
- The lowest daily minimum of 24.8 degrees F occurred in January 1999 and December 1998.
- The average daily temperature is 59 degrees F.

The monthly average rainfall exceeds 0.98 inches from November through March. The rest of the year is relatively dry with monthly average rainfall totals less than 0.98 inches.

- The maximum annual rainfall during the past five years was 20.6 inches occurring 1998.
- The minimum annual rainfall during the past five years was 9.64 inches occurring 1999.
- The average rainfall during the past five years was 12.9 inches.

Figure 4-14 presents a wind rose for 1996 through 2000 depicting wind speed and wind direction frequency. The predominant wind direction frequency is from the southwest and the maximum wind speeds occur from this direction. The windiest months occur in the spring and summer and are dominated by the westerly sea breezes. The winds during the fall and winter are typically lighter and more varied in direction.

- The maximum 1-hour average wind speed was 41.0 feet per second (ft/sec) during February 1997.
- The monthly average wind speed was 8.2 ft/sec.

Atmospheric stability is a measure of the atmosphere's ability to disperse pollutants. Pollutants tend to disperse more rapidly in unstable atmospheres. The atmospheric

## Attainment–What is it?

The EPA designates all areas of the U.S. as having air quality either better than the NAAQS ("attainment"), worse than the NAAQS ("nonattainment"), or "unclassified" (when there is a lack of data for EPA to form a basis of attainment status).

stability is generally neutral due to the persistent winds. Moderately stable or very unstable atmospheres occur throughout the year.

#### 4.8.3.3 Sandia National Laboratories, California Air Quality

The EPA designates all areas of the United States as having air quality better than the NAAQS ("attainment"), worse than the NAAQS ("nonattainment"), or "unclassified." Pollutants in an area are often designated as unclassified when there is a lack of data for the EPA to form a basis of attainment status. In addition, the severity or magnitude of the exceedance for the criteria pollutants is determined by the amount that ambient air quality measurements are above the NAAQS. Based on the 1990 *Clean Air Act Amendments*, ozone nonattainment areas are classified as marginal, moderate, serious, severe, or extreme. Similarly, carbon monoxide (CO) and respirable particulate matter ($PM_{10}$) nonattainment areas are classified as moderate or serious (SNL/CA 2002b).

EPA has denoted the ozone classification of the nonattainment status for the criteria pollutant ozone in the San Francisco Bay Area as "Other." On July 10, 1998, EPA published a final rule (63 FR 37258) redesignating the San Francisco Bay area to ozone nonattainment with the federal 1-hour ozone NAAQS. This redesignation was authorized under the general nonattainment provisions of Subpart 1 of the Clear Air Act. The Bay Area, therefore, does not have a Subpart 2 classification. When comparing to the traditional Subpart 2 classification, the Bay Area's value is equivalent to that of a moderate area. In simple terms, "Other" is the equivalent of a "Moderate" nonattainment classification for ozone. The San Francisco-Oakland-San Jose area is classified by EPA as a carbon monoxide maintenance area.

California has adopted SAAQS that are more stringent for criteria pollutants than the NAAQS. In addition to the federal attainment designation, each air district has a state attainment designation. The California Air Resources Board (CARB) has designated the San Francisco Bay Area as nonattainment for ozone and $PM_{10}$ and as in attainment of all other criteria pollutants.

Pollutant monitoring results near SNL/CA indicate that the air quality in the Livermore area has generally been good. Table 4-2 presents a comparison of the NAAQS and SAAQS with criteria pollutant monitoring results for 1996 through 2000 from the closest monitoring stations to SNL/CA. The monitoring data indicate that the 24-hour $PM_{10}$ state standard was exceeded by the highest maximum concentration during 1997 through 2000 and by the second highest maximum concentration during 1998 through 2000. The 1-hour ozone state standard was exceed by the highest and second highest maximum concentration for the period 1996 through 2000 while the NAAQS was exceeded by the highest and second highest maximum concentration during 1996, 1998, 1999, and 2000. Concentrations of the remaining criteria pollutants are below the NAAQS and SAAQS. Figure 4-15 shows the location of the monitoring stations from which data presented in Table 4-2 were complied.

During the past five years, the number of permitted air emission sources at SNL/CA has decreased. However, air emissions from permitted sources have increased. The total pollutants emitted are not considered significant and have a minimal impact on the region's air quality.

The number of permitted sources onsite has decreased from 29 to 20 (in 2002 the number decreased to 17) during the past five years. Table 4-3 presents each of 17 permitted emission source at SNL/CA and the types of significant emissions reported with the July 1, 2000 to June 2001 Permit to Operate.

Table 4-4 lists the criteria pollutant emissions from permitted sources during the past five years, the estimated emissions for the whole Bay Area, and the percent of SNL/CA emissions relative to district-wide emissions. Criteria pollutant emissions from SNL/CA are much less than one percent of those of the entire Bay Area. Table 4-5 presents the toxic pollutant emissions from permitted sources during the past five years, the estimated toxic emissions for the whole Bay Area, and the percent of SNL/CA toxic emissions relative to district wide emissions. Toxic pollutant emissions from SNL/CA are minor compared to those of the Bay Area.

**Table 4-2. Comparison of 1996 to 2000 Criteria Pollutant Monitoring Results with Applicable National and California Ambient Air Quality Standards**

| Pollutant | Units | Averaging Period | State Standards | NAAQS | | Measurements[e] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1996 | 1997 | 1998 | 1999 | 2000 |
| CO[(a)] | ppm | 1-hour | 20 | 35 | 1st Max | 4.9 | 4.6 | 4.3 | 5.2 | 4.5 |
| | | | | | 2nd Max | 4.7 | 4.4 | 4.1 | 4.5 | 4.4 |
| | | 8-hour | 9.0 | 9 | 1st Max | 2.5 | 2.5 | 2.4 | 2.9 | 2.7 |
| | | | | | 2nd Max | 2.4 | 2.3 | 2.3 | 2.5 | 2.5 |
| $NO_2$[(b)] | ppm | 1-hour | 0.25 | -- | 1st Max | 0.086 | 0.082 | 0.071 | 0.094 | 0.073 |
| | | | | | 2nd Max | 0.079 | 0.074 | 0.069 | 0.088 | 0.07 |
| | | Annual Arithmetic Mean | -- | 0.053 | -- | 0.019 | 0.018 | 0.019 | 0.02 | 0.017 |
| $PM_{10}$[(a)] | $\mu g/m^3$ | 24-hour | 50 | 150 | 1st Max | 47 | 55 | 56 | 119 | 70 |
| | | | | | 2nd Max | 44 | 48 | 52 | 94 | 55 |
| | | Annual Arithmetic Mean | -- | 50 | -- | 19.8 | 20.5 | 17.8 | 22.7 | 21.7 |
| | | Annual Geometric Mean | 30 | -- | -- | -- | -- | -- | -- | -- |
| Ozone[(b)] | ppm | 1-hour | 0.09 | 0.12 | 1st Max | 0.138 | 0.114 | 0.146 | 0.146 | 0.137 |
| | | | | | 2nd Max | 0.137 | 0.111 | 0.139 | 0.144 | 0.126 |

**Table 4-2. Comparison of 1996 to 2000 Criteria Pollutant Monitoring Results with Applicable National and California Ambient Air Quality Standards**

| Pollutant | Units | Averaging Period | State Standards | NAAQS | | Measurements[e] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1996 | 1997 | 1998 | 1999 | 2000 |
| $SO_2$[(c)] | ppm | 1-hour | 0.25 | -- | 1st Max | 0.019 | 0.038 | 0.049 | 0.048 | 0.02 |
| | | | | | 2nd Max | 0.019 | 0.02 | 0.037 | 0.037 | 0.016 |
| | | 3-hour | -- | 0.5 | 1st Max | 0.013 | 0.018 | 0.029 | 0.03 | 0.014 |
| | | | | | 2nd Max | 0.013 | 0.016 | 0.026 | 0.025 | 0.011 |
| | | 24-hour | 0.04 | 0.14 | 1st Max | 0.005 | 0.007 | 0.009 | 0.012 | 0.004 |
| | | | | | 2nd Max | 0.005 | 0.006 | 0.008 | 0.011 | 0.004 |
| | | Annual Arithmetic Mean | -- | 0.03 | -- | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Lead[(d)] | $\mu g/m^3$ | 30 Days | 1.5 | -- | -- | -- | -- | -- | -- | -- |
| | | Quarter | -- | 1.5 | 1 Qtr | 0.004 | 0.003 | 0.01 | 0.01 | NA |
| | | | | | 2 Qtr | 0.003 | 0.003 | 0.003 | 0.003 | NA |
| | | | | | 3 Qtr | 0.01 | 0.01 | 0.02 | 0.0 | NA |
| | | | | | 4 Qtr | 0.01 | 0.004 | 0.01 | 0.0 | NA |

Source: SNL/CA 2002b
[a]2614 Old 1st St., Livermore station (1996–1999) and 793 Rincon Ave., Livermore station (2000)
[b]2614 Old 1st St., Livermore station
[c]Concord station
[d]Fremont station
[e]Measurements are from the four offsite locations listed above.
CO: Carbon Monoxide
$\mu g/m^3$: micrograms per cubic meter
NA: not available/not applicable
NAAQS: National Ambient Air Quality Standards
$NO_2$: Nitrous Dioxide
PM: Particulate Matter
ppm: parts per million
Qtr: Quarter
$SO_2$: Sulfur Dioxide

**Table 4-3. Sandia National Laboratories, California Permitted Sources and Types of Pollutants Reported**

| Source Number | Source Description | Source Location | Types of Pollutants Reported[a, b] |
|---|---|---|---|
| 6 | Boiler (5 MM BTU/hr) | Bldg 907 | $NO_x$, Toxics |
| 7 | Boiler (5 MM BTU/hr) | Bldg 907 | $NO_x$, Toxics |
| 22 | Boiler (1200 K BTU/hr) | Bldg 916 | $NO_x$, Toxics |
| 25 | Boiler (3200 K BTU/hr) | Bldg 912 SW | $NO_x$, Toxics |
| 26 | Boiler (3000 K BTU/hr) | Bldg 968 | $NO_x$, Toxics |
| 27 | Boiler (3000 K BTU/hr) | Bldg 968 | $NO_x$, Toxics |
| 28 | Boiler (3500 K BTU/hr) | Bldg 910 | $NO_x$, Toxics |
| 29 | Boiler (3500 K BTU/hr) | Bldg 910 | $NO_x$, Toxics |
| 33 | Degreaser | Bldg 910 | Toxics |
| 34 | Degreaser | Bldg 34 | Toxics |
| 55 | Misc. Chemical (Decontamination Sink) | Bldg 961 | NR |
| 56 | Misc. Chemical (Waste Compactor) | Bldg 961 | Toxics |
| 60 | Misc. Chemical (Drum Crusher) | Bldg 961 | Toxics |
| 77 | Electroplating | Bldg 943 | NR |
| 81 | Boiler (7350 K BTU/hr) | Bldg 943 | $NO_x$, CO, Toxics |
| 82 | Boiler (7350 K BTU/hr) | Bldg 943 | $NO_x$, CO, Toxics |
| 95 | Solvent Use (Wipe Cleaning) | Site-wide | VOC, Toxics |

Source: SNL/CA, 2002b
Note: Fugitive toxic emissions (site-wide) are also covered as a permitted source.
[a]Exempt sources not included
[b]Report period is July to June
BTU: British Thermal Unit
CO: carbon monoxide
K: kilo
MM: million
$NO_x$: Oxides of Nitrogen
NR: None reported for 2000-2001
VOC: volatile organic compound

**Table 4-4. Criteria Pollutant Emission Rates (kilograms per year)**

| Pollutant | SNL/CA | | | | | Bay Area[b] | Percent Contribution from SNL/CA |
|---|---|---|---|---|---|---|---|
| | Emission Year[a, b] | | | | | | |
| | 96/97 | 97/98 | 98/99 | 99/00 | 00/01 | 2000 | |
| Particulates | NA | NA | NA | NA | NA | 57,900,000 | NA |
| Volatile Organic Compounds | 497 | NA | 497 | 662 | 1656 | 179,000,000 | < 1 |
| Sulfur Dioxide | NA | NA | NA | NA | NA | 29,100,000 | NA |
| Nitrogen Dioxide | 3,146 | 3,973 | 3,311 | 3,642 | 3,311 | 214,000,000 | < 1 |
| Carbon Monoxide | 165 | 165 | NA | NA | 331 | 995,000,000 | < 1 |

Sources: SNL/CA 2002b
[a]Bay Area Air Quality Management District (BAAQMD) inventory is reported annually for period July to June.
[b]All Bay Area wide emissions except particulates are based on an average summer day multiplied by 365 days. Bay Area particulate emissions are based on an average winter day multiplied by 365 days.
<: less than
NA: Not Available
SNL/CA: Sandia National Laboratories, California

**Table 4-5. Toxic Air Pollutant Emission Rates (kilograms per year)**

| Pollutant | SNL/CA | | | | | Bay Area | Percent Contribution from SNL/CA |
|---|---|---|---|---|---|---|---|
| | Emission Year[a] | | | | | | |
| | 96/97 | 97/98 | 98/99 | 99/00 | 00/01 | 1999 | |
| 1,1,1-trichloroethane | 91.226 | 39.01 | 144.24 | 235.1 | 96.15 | 58,968 | < 1 |
| 1,4-dioxane | 4.189 | 0.00 | 2.81 | 5.5 | 0.54 | 771 | < 1 |
| Ammonia | 238.412 | 205.93 | 99.79 | 33.4 | 1.31 | 1,406,160 | < 1 |
| Benzene | 0.31 | 0.32 | 0.32 | 0.32 | 0.30 | 28,577 | < 1 |
| Carbon tetrachloride | 0.006 | 0.36 | 0.00 | 0.00 | 0.00 | 1,406 | NA |
| Formaldehyde | 3.133 | 3.4 | 3.22 | 3.26 | 3.12 | 81,648 | < 1 |
| Methyl alcohol | 1.821 | 1.86 | 0.00 | 167.22 | 681.77 | 276,696 | < 1 |
| Methylene chloride | 11.027 | 16.78 | 49.9 | 50.2 | 75.55 | 49,896 | < 1 |
| Perchloroethylene | 13.013 | 24.49 | 74.84 | 42.7 | 73.55 | 371,952 | < 1 |
| Toluene | 0.07 | 0.09 | 0.09 | 3.3 | 43.04 | 335,664 | < 1 |
| Trichloroethylene | 66.391 | NA | NA | 0.00 | 2.93 | 21,773 | < 1 |
| Xylene | 0.015 | 0.01 | 0.01 | 0.002 | 14.77 | 276,696 | < 1 |

Sources: SNL/CA 2002b
[a]Bay Area Air Quality Management District (BAAQMD) inventory is reported annually for period July to June.
<: less than
NA: Not Available
SNL/CA: Sandia National Laboratories, California

## 4.9 INFRASTRUCTURE

### 4.9.1 Definition of Resource

Infrastructure consists of buildings, services, maintenance, utilities, material storage, and transportation systems and corridors that support the operations of a facility. Specifically, SNL/CA's infrastructure consists of water, sanitary sewer systems, storm drains, electrical transmission and distribution, communication systems, roads, and parking lots that support operations at the site. For a discussion of land use, see Section 4.3.

### 4.9.2 Region of Influence

The ROI for infrastructure is within the site boundary. Table 4-6 presents information on the type of utilities and amounts used by SNL/CA, and identifies utility capacities.

### 4.9.3 Affected Environment

#### 4.9.3.1 Sandia National Laboratories, California Buildings

Buildings within SNL/CA are listed by type and square footage in Table 4-7. Physical attributes such as construction type, gsf, and usage distinguish primary buildings.

#### 4.9.3.2 Sandia National Laboratories, California Services and Maintenance

SNL/CA's management and operations (M&O) contractor is Lockheed Martin Corporation. SNL is organized into twelve divisions including the California laboratory (SNL/CA). Extensive descriptions of key programs and services are provided in the *SNL Institutional Plan Fiscal Year 2002-2007* (SNL 2001a). SNL/CA has a maintenance program supported by appropriate NEPA review. Routine maintenance and upgrades include the following:

- cleaning, painting, repairing, renovating, and servicing buildings, equipment, vehicles, and utility infrastructure;
- maintaining and extending onsite roads, parking areas, and access control structures;
- replacing, upgrading, and maintaining equipment, tools, and components, such as computers, valves, pumps, filters, monitors, and equipment controls to preserve, improve, and extend the life of the infrastructure; and
- maintaining, replacing, and upgrading environment, safety, and health equipment, controls, and monitoring capabilities.

#### 4.9.3.1 Roadways and Transportation Access

The general road network in SNL/CA area is shown in Figure 4-16. Interstate 580 is the east-west access to the regional Interstate system and is approximately 2 miles north of the SNL/CA boundary. Access to SNL/CA consists of an urban road network maintained by the City of Livermore, and SNL/CA maintained gates and roadways.

Traffic enters SNL/CA through two principal gates off East Avenue. Commercial traffic enters through the East